

Claims

[c1] 1. A method for insulating the fuselage of an aircraft, the fuselage having an outer skin, a plurality of stringers coupled to and extending latitudinally along said outer skin, and a plurality of frames coupled to said plurality of stringers and said outer skin and extending longitudinally along said outer skin, the method comprising: forming a hydrophobic, open-cell foam structure capable of being compressed between about 0.5 and 10 percent; sizing said hydrophobic, open-celled foam structure to fit between an adjacent pair of said plurality of frames; compression fitting at least one layer of said hydrophobic, open-cell foam structure between said adjacent pair of frames such that said layer substantially covers at least one of the plurality of stringers; and coupling a trim piece over said layer such that said layer is sandwiched between said trim piece and said outer skin.

[c2] 2. The method of claim 1, wherein forming said hydrophobic open-cell foam structure comprises: forming a melamine-based open-celled thermosetting

foam; and

applying a moisture resistant compound to said melamine-based open-celled thermosetting foam.

- [c3] 3. The method of claim 2, wherein applying a moisture resistant compound comprises applying a silicon compound to said melamine-based open-celled thermosetting foam.
- [c4] 4. The method of claim 1, further comprising forming a channel within said hydrophobic, open-celled foam structure near said outer skin, said channel facilitating the removal of water from said hydrophobic, open-cell foam structure.
- [c5] 5. The method of claim 1, further comprising coupling a non-woven spun-laced fiber fabric layer between said trim piece and said hydrophobic, open-cell foam structure.
- [c6] 6. The method of claim 1, wherein compression fitting at least one layer of said hydrophobic, open-cell foam structure comprises:
 - (a) introducing a first layer of said hydrophobic, open cell foam structure on either side of each of the stringers contained between an adjacent pair of frames such that each of said respective first layers is compression fit be-

tween said pair of frames, wherein each of said first layers has an outer surface, wherein the relative distance of a top portion of each of said stringers is located farther from the outer skin than the relative distance of each of said outer surfaces;

- (b) forming a first insulation material by: coupling a second interleaved fibrous layer between a second layer and a third layer of said hydrophobic, open-cell foam structure;
- (c) coupling a plurality of spacers to said outer surface of said each of said first layers such that each of said first layers is located between the outer skin and each of said plurality of spacers; and
- (d) coupling said first insulation material between said adjacent pair of frames such that said plurality of spacers are contained between said first layer and said first insulation material, therein forming an air gap between said first insulation material and said first layer, wherein said second layer and said third layer are compression fit between said adjacent pair of frames.

[c7] 7. The method of claim 1, wherein compression fitting at least one layer of said hydrophobic, open-cell foam structure comprises:

- (a) compression fitting a first layer of said hydrophobic, open-cell foam structure between said adjacent pair of

frames such that said layer substantially covers at least one of the plurality of stringers;

(b) coupling a plurality of spacers onto said first layer;

(c) forming an insulation material by:
coupling an interleaved fibrous layer to a second layer of said hydrophobic, open-cell foam structure; and

(d) coupling said insulation material onto said plurality of spacers and within said adjacent pair of frames such that said second layer is compression fit between said adjacent pair of frames.

[c8] 8. The method of claim 1, wherein compression fitting at least one layer of said hydrophobic, open-cell foam structure comprises:

(a) forming an insulation material by:
coupling an interleaved fibrous layer to a first layer of said hydrophobic, open-cell foam structure;
coupling a second layer of said hydrophobic, open-cell foam structure to said interleaved fibrous layer such that said interleaved fibrous layer is sandwiched between said first layer and said second layer; and

(b) compression fitting said insulation material between said adjacent pair of frames such that said first layer substantially covers at least one of the plurality of stringers.

[c9] 9. The method of claim 1, wherein compression fitting at least one layer of said hydrophobic, open-cell foam structure comprises:

(a) forming an insulation material by:
coupling an interleaved fibrous layer to a first layer of said hydrophobic, open-cell foam structure;
coupling a second layer of said hydrophobic, open-cell foam structure to said interleaved fibrous layer such that said interleaved fibrous layer is sandwiched between said first layer and said second layer;
coupling a spacer to each end of said interleaved fibrous layer, wherein each spacer is contained between said first layer and said second layer; and
(b) compression fitting said insulation material between said adjacent pair of frames such that said first layer substantially covers at least one of the plurality of stringers.

[c10] 10. The method of claim 1, wherein compression fitting at least one layer of said hydrophobic, open-cell foam structure comprises:

(a) forming a first insulation material by:
coupling a first interleaved fibrous layer to a first layer of said hydrophobic, open-cell foam structure;
(b) forming a second insulation material by:
coupling a second interleaved fibrous layer to a second

layer of said hydrophobic, open-cell foam structure;

(c) compression fitting said first insulation material between said adjacent pair of frames such that said first layer substantially covers at least one of the plurality of stringers;

(d) coupling a plurality of spacers to a top surface of said first insulation material; and

(e) coupling said second insulation material between said adjacent pair of frames such that said plurality of spacers are contained between said first insulation material and said second insulation material, therein forming an air gap between said first insulation material and said second insulation material, wherein said second layer is compression fit between said adjacent pair of frames.

[c11] 11. The method of claim 10, wherein said spacers are directly coupled to and between said first interleaved fibrous layer and said first layer.

[c12] 12. The method of claim 10, wherein said spacers are directly coupled to and between said first interleaved fibrous layer and said second interleaved fibrous layer.

[c13] 13. The method of claim 1, wherein compression fitting at least one layer of said hydrophobic, open-cell foam structure comprises:

(a) compression fitting a first layer of said hydrophobic,

open-cell foam structure between said adjacent pair of frames such that said layer substantially covers at least one of the plurality of stringers;

(b) coupling a plurality of spacers onto said first layer;

(c) forming an insulation material by:

coupling an interleaved fibrous layer to one layer of said hydrophobic, open-cell foam structure;

coupling a second layer of said hydrophobic, open-cell foam structure to said interleaved fibrous layer such that said interleaved fibrous layer is sandwiched between said first layer and said second layer; and

(d) coupling said insulation material between said adjacent pair of frames such that said plurality of spacers are contained between said first layer and said insulation material, therein forming an air gap between said insulation material and said first layer, wherein said second layer is compression fit between said adjacent pair of frames.

[c14] 14. The method of claim 1 further comprising:

introducing a cutout portion to one layer of said at least one layers prior to compression fitting said one layer between said frames;

compression fitting said one layer of said hydrophobic, open-cell foam structure between said adjacent pair of frames such that said layer substantially covers a top

section and a bottom section of a c-shaped frame element, wherein said c-shaped frame element comprises a portion each of said frames.

- [c15] 15. An insulation system for use in an aircraft fuselage, the fuselage having an outer skin, a plurality of stringers coupled to and extending latitudinally along an outer skin, and a plurality of frames coupled to a plurality of stringers and the outer skin and extending longitudinally along the outer skin, each of the plurality of frames having a c-shaped frame element coupled to an I-shaped frame element, the insulation system comprising:
 - at least one layer of said hydrophobic, open-cell foam structure compression fit between an adjacent pair of the plurality of frames and closely coupled to the outer skin, wherein said at least one layer substantially covers at least one of the plurality of stringers; and
 - a trim piece coupled to said at least one layer.
- [c16] 16. The insulation system of claim 15, wherein said hydrophobic, open cell foam structure comprises a melamine-based, thermosetting open cell foam structure.
- [c17] 17. The insulation system of claim 15, wherein said hydrophobic, open cell foam structure comprises a melamine-based, thermosetting open cell foam structure

being compressible to between about 0.5 and 10 percent compression.

- [c18] 18. The insulation system of claim 15 further comprising a layer of non-woven spun laced fiber fabric coupled between said at least one layer and said trim piece.
- [c19] 19. The insulation system of claim 15, wherein a portion of said at least one layer located in closest proximity to the outer skin is removed to provide a drainage channel.
- [c20] 20. The insulation system of claim 15, wherein said at least one layer located in closest proximity to the outer skin has a cut out portion, said cut out portion allowing said at least one layer to be compression fit to an inner extending portion and a bottom portion of one of said c-shaped frame elements.
- [c21] 21. The insulation system of claim 18, wherein said at least one layer comprises:
 - a first layer of a hydrophobic, open-cell foam structure compression fit between an adjacent pair of the plurality of frames and closely coupled to the outer skin, wherein said first layer substantially covers at least one of the plurality of stringers;
 - a second layer of said hydrophobic, open-cell foam structure closely coupled to said trim piece; and

an interleaved fibrous layer sandwiched between said first layer and said second layer.

- [c22] 22. The insulation system of claim 21, wherein said first layer has a cut out portion, said cut out portion allowing said first layer to be compression fit to an inner extending portion and a bottom portion of one of said c-shaped frame elements.
- [c23] 23. The insulation system of claim 21 further comprising a pair of hydrophobic, open cell spacer elements coupled to each end of said interleaved fibrous layer within said adjacent pair of said frames, each of said pair being located between said first layer and said second layer.
- [c24] 24. The insulation system of claim 23, wherein said first layer has a cut out portion, said cut out portion allowing said first layer to be compression fit to an inner extending portion and a bottom portion of one of said c-shaped frame elements.
- [c25] 25. An insulation system for use in an aircraft fuselage, the fuselage having an outer skin, a plurality of stringers coupled to and extending latitudinally along an outer skin, and a plurality of frames coupled to a plurality of stringers and the outer skin and extending longitudinally along the outer skin, each of the plurality of frames hav-

ing a c-shaped frame element coupled to an l-shaped frame element, the insulation system comprising:
a first insulation system including at least one layer of a hydrophobic, open-cell foam structure compression fit between an adjacent pair of the plurality of frames and closely coupled to the outer skin, wherein said at least one layer substantially covers at least one of the plurality of stringers;
a trim piece;
a second insulation system including at least other layer of said hydrophobic, open-cell foam structure compression fit between said adjacent pair of the plurality of frames, said second insulation system being located between said first insulation system and said trim piece;
and
a plurality of spacers located between said first insulation system and said second insulation system, said plurality of spacers creating an air gap between said first insulation system and said second insulation system.

[c26] 26. The insulation system of claim 25, wherein said hydrophobic, open cell foam structure comprises a melamine-based, thermosetting open cell foam structure.

[c27] 27. The insulation system of claim 25, wherein said hydrophobic, open cell foam structure comprises a

melamine-based, thermosetting open cell foam structure being compressible to between about 0.5 and 10 percent compression.

- [c28] 28. The insulation system of claim 25 further comprising a layer of non-woven spun laced fiber fabric coupled between said second insulation system and said trim piece.
- [c29] 29. The insulation system of claim 25, wherein said at least one layer in said first insulation system located in closest proximity to the outer skin has a cut out portion, said cut out portion allowing said at least one layer in said first insulation system to be compression fit to an inner extending portion and a bottom portion of one of said c-shaped frame elements.
- [c30] 30. The insulation system of claim 26, wherein said first insulation system comprises a layer of said hydrophobic, open cell foam structure.
- [c31] 31. The insulation system of claim 30, wherein said first insulation system further comprises a layer of non-woven spun laced fiber fabric coupled between to said layer, wherein said layer of non-woven spun laced fiber fabric is located between said layer and said plurality of spacers.
- [c32] 32. The insulation system of claim 30, wherein said sec-

ond insulation system comprises:
a second layer of said hydrophobic, open cell foam
structure; and
a layer of non-woven spun laced fiber fabric coupled be-
tween said second insulation system and said trim piece.

[c33] 33. The insulation system of claim 30, wherein said sec-
ond insulation system comprises:
a second layer of said hydrophobic, open cell foam
structure;
a third layer of said hydrophobic, open cell foam struc-
ture; and
a layer of non-woven spun laced fiber fabric coupled be-
tween said second layer and said third layer.

[c34] 34. The insulation system of claim 31, wherein said sec-
ond insulation system comprises:
a second layer of said hydrophobic, open cell foam
structure; and
a layer of non-woven spun laced fiber fabric coupled be-
tween said second layer and said trim piece.

[c35] 35. The insulation system of claim 31, wherein said sec-
ond insulation system comprises:
a layer of non-woven spun laced fiber fabric; and
a second layer of said hydrophobic, open cell foam
structure coupled between said layer of non-woven spun

laced fiber fabric and said trim piece.